



Proton Plan PMG 4/18/05

NuMI Target Situation/Status

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Period March 23, 2005 thru April 4, 2005:

- 1) A water leak developed from the target RAW (radioactive water) cooling system into the Target Vacuum space. This developed around March 23rd. Target scans with low power beam read out with the Hadron Monitor at the absorber confirmed this. Leak rate measurements were made to determine the size of the "hole."**
- 2) The entire volume of the target vacuum space was filled with water.**
- 3) Attempts to pump the water out through the vacuum port after turning off the RAW water supply were unsuccessful.**
- 4) Over-pressurizing the vacuum space with Helium was able to drive some water back through the hole into the (now empty) water lines.**
- 5) Low power target scans showed that water (to about the vertical halfway point on the target) was forced out.**



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NuMI Target Situation/Status(2)

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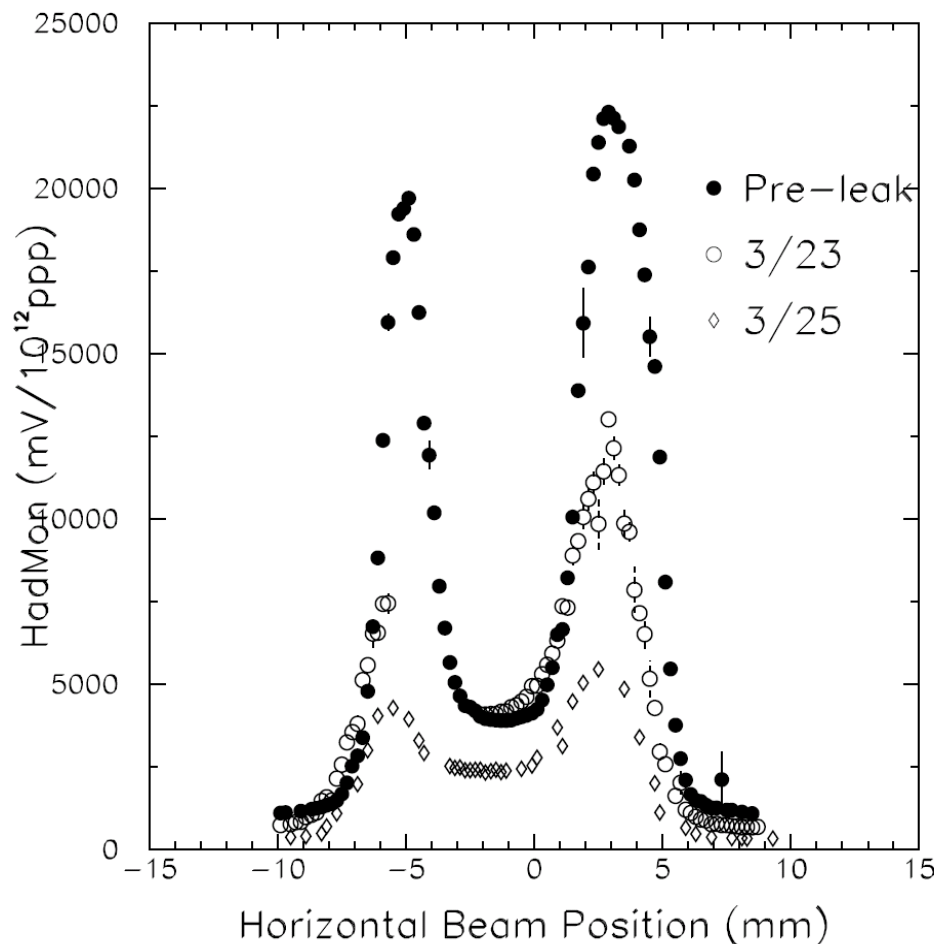
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- 6) Over the weekend April 2-3, 2005, it became evident that even with a modest tipping of the target assembly we were unable to remove more water - we had reached the level of the hole and substantial water remained in the target snout below the present level of the water. We cannot run at high enough proton intensity to be useful with water surrounding the target graphite.**
- 7) A plan was made that starting Tuesday April 5th to pull the target assembly from the target chase and move it to the work cell.**
- 8) We did know then the exact level of activation of the target assembly. A crude measurement was made by dropping a probe through a survey port. As we carefully took things apart we monitored the radiation levels, and the activation as found has had a controlling influence on the amount of work and investigation, and at what distances, has been possible.**



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NuMI Target Situation/Status(3)

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This plot shows the results of Horizontal Scans across the target. Transmission to the Hadron Monitor just before the absorber is plotted. On the left the beam is completely absorbed by the baffle. Then the beam crosses the vacuum space between the target and baffle, maximizing transmission, and then hits the target, and repeats in reverse to the right.

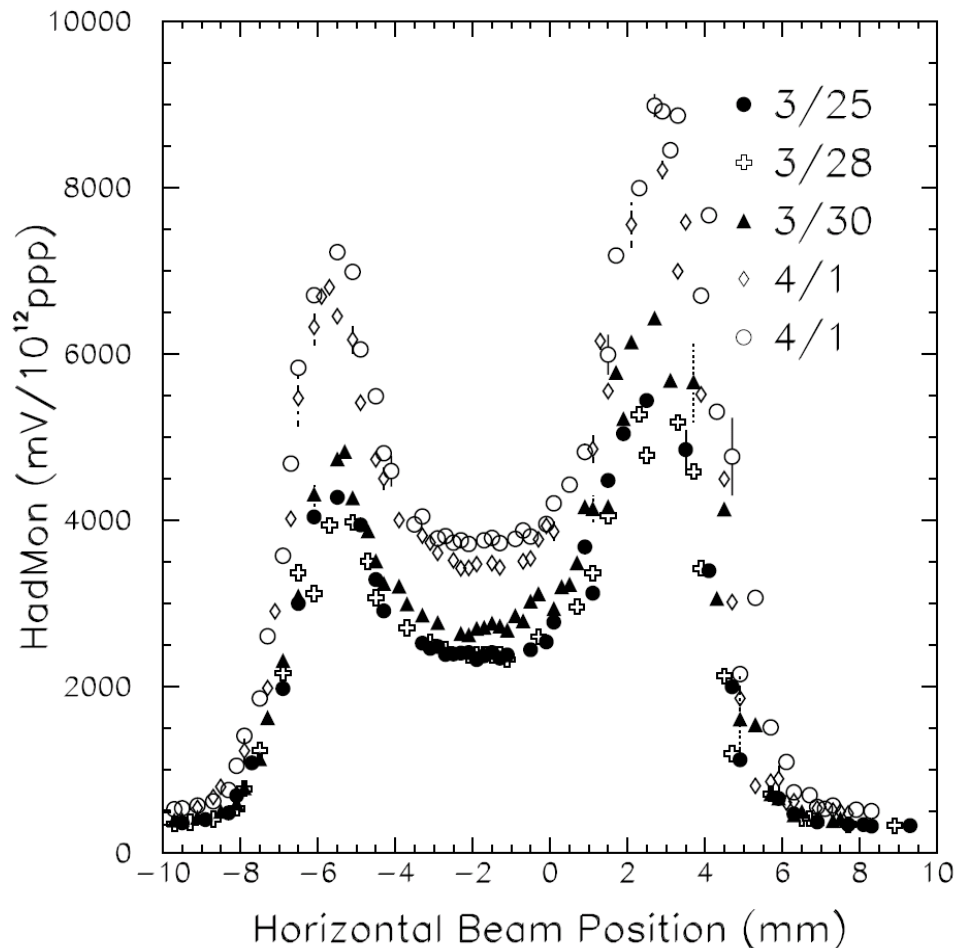
Note that transmission falls in successive scans as the target fills with water.



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NuMI Target Situation/Status(4)

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This plot shows the results of more Horizontal Scans across the target. Transmission to the Hadron Monitor just before the absorber is plotted.

Note that transmission rises in successive scans as some of the water is pushed out of the hole by over-pressurizing the vacuum space with Helium.

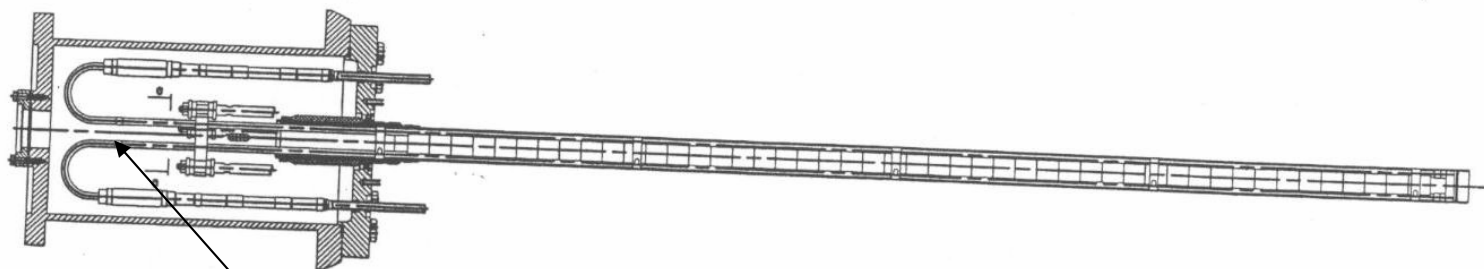


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NuMI Target Situation/Status(5)

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THE NuMI TARGET



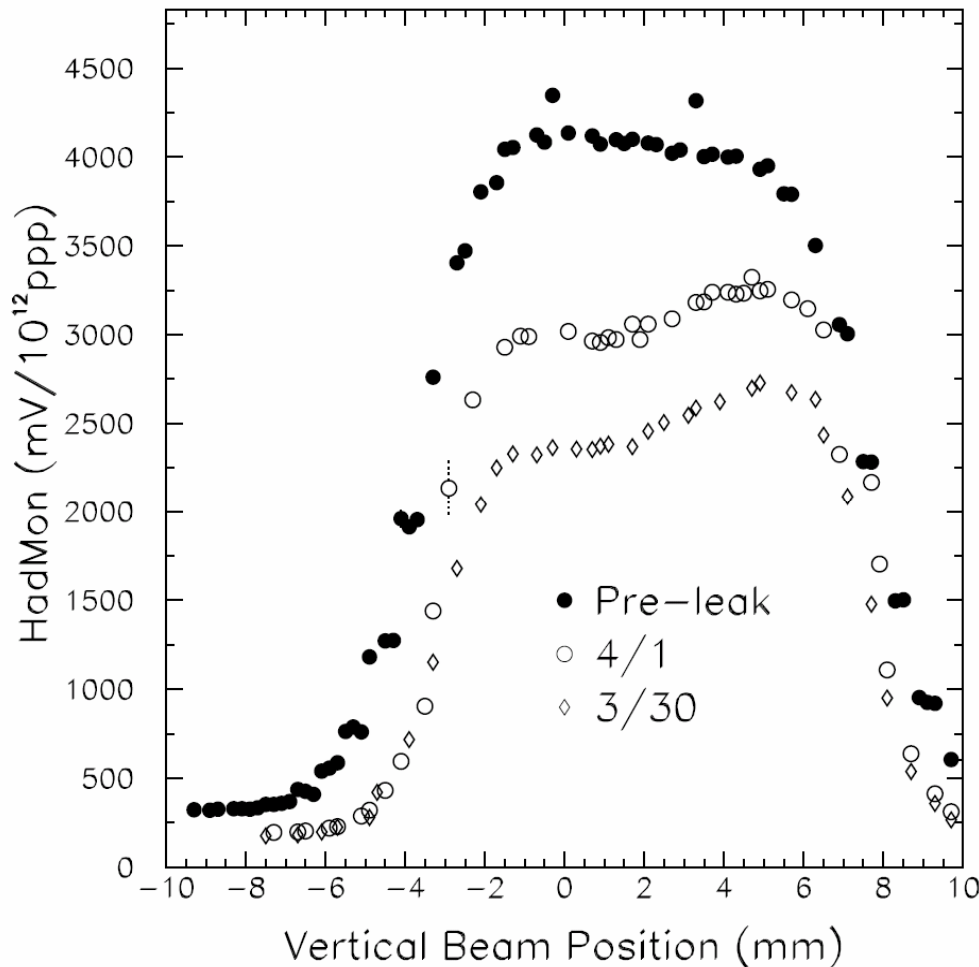
Leak was thought to be here.



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NuMI Target Situation/Status(6)

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This plot shows the results Of Vertical Scan across the target. Transmission to the Hadron Monitor just before the absorber is plotted.

Note that transmission rises in successive scans as some of the water is pushed out of the hole by over-pressurizing the vacuum space with Helium.



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NuMI Target Situation/Status(7)

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- 9) A bench test of a "back pressurizing" design where we will run with slightly over pressured Helium in the "Vacuum" space to keep the water from coming out the "hole" has been successful - i.e. we should be able to contain the leak by keeping the Helium pressure higher than the cooling RAW water pressure.
- 10) A "stop leak" material is available from England that has been used successfully in reactors. We are ready to call upon them if the leak location is found.
- 11) We are investigating a stopgap "somewhat lower energy" (i.e. lower intensity of protons on target) air-cooled target design. This is a NEW design and will take many weeks minimally.
- 12) The assembly of the "spare" target is being pushed: July is the most likely projection.



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NuMI Target Situation/Status(8)

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Developments during the week 4/4/05 thru 4/11/05:

- 1) On Monday April 4 the decision was made to pull the target module. This includes the target, upstream baffle, target/baffle carrier, and the support structure.**
- 2) The shield door to the target hall was opened.**
- 3) 25 “R” blocks were removed from the top of the target pile.**
- 4) Additional shield blocks necessary to complete storage vaults for “Steel ‘T’” blocks and other shielding were brought into the target hall and the vaults were assembled.**
- 5) Shielding around the Target module was removed and stored.**



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- 6) A preliminary radiation survey was made while the target module was still in the target pile but after the shielding was removed. The levels were low to moderate, but it was not possible to separate the contributions from the target module and the surrounding steel in the pile.**
- 7) In parallel with all the above work the work cell was prepared to receive the module.**
- 8) On Friday April 8 the module was pulled and transported to the work cell. A map of the activation of the module components was made. Away from the target “snout” the activation was generally reported to be near 100 mr at a foot. The most activated region was in the middle of the snout near shower maximum where it was 1200 mr/hr at 2 inches.**
- 9) Preparations were completed for an optical survey of the “snout” to determine if the weight of the water had bent it.**



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10) The survey of the “snout” position was completed Saturday April 9. The snout horizontal position was essentially unchanged, but vertically the snout tip may have been bent down about 1mm.

11) A work list was prepared including estimates for the radiation exposure to staff for each step. The major task included the removal of the upstream target baffle from the carrier, and the removal of the upstream beryllium window for access into the can region.



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NuMI Target Situation/Status(11)

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Week of April 11 to April 18

- 1) On Monday April 11 the removal of the upstream target baffle from the carrier, and the removal of the upstream beryllium window for access into the can region was completed. Total Staff exposure was under about 14mr for this work.**
- 2) Bore scopes were used to inspect the interior of the target can. Pictures of the bore scope monitor were recorded from the video tapes.**
- 3) On Tuesday April 12 the Alignment staff measured the locations of the target cooling tubes with respect to the nominal beam location. It was determined that they DID NOT extend into the beam region and WERE almost completely shadowed by the upstream baffle.**
- 4) Attempts to locate the leak, first with pressurized Helium, and then water in the cooling tubes have been unsuccessful; the leak appears to be plugged.**



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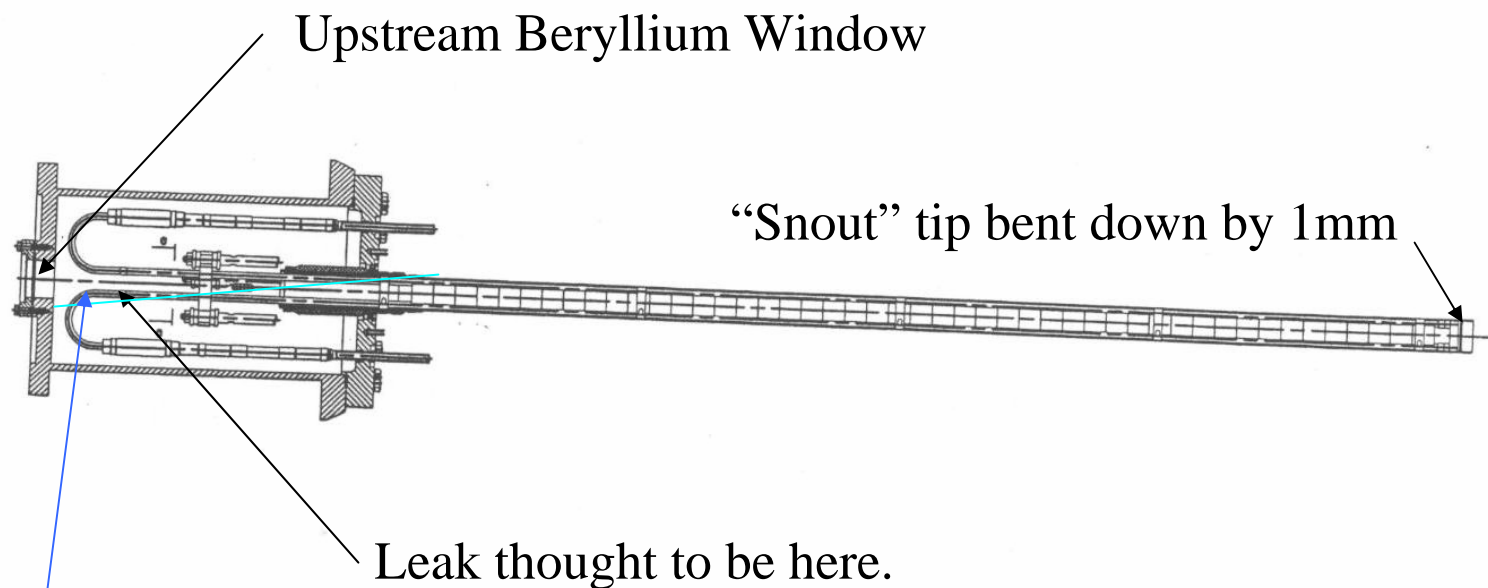


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NuMI Target Situation/Status(13)

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THE NuMI TARGET



Water level here when viewed with optical probe.

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NuMI Target Situation/Status(14)

The NuMI Target



**Graphite
target tiles**

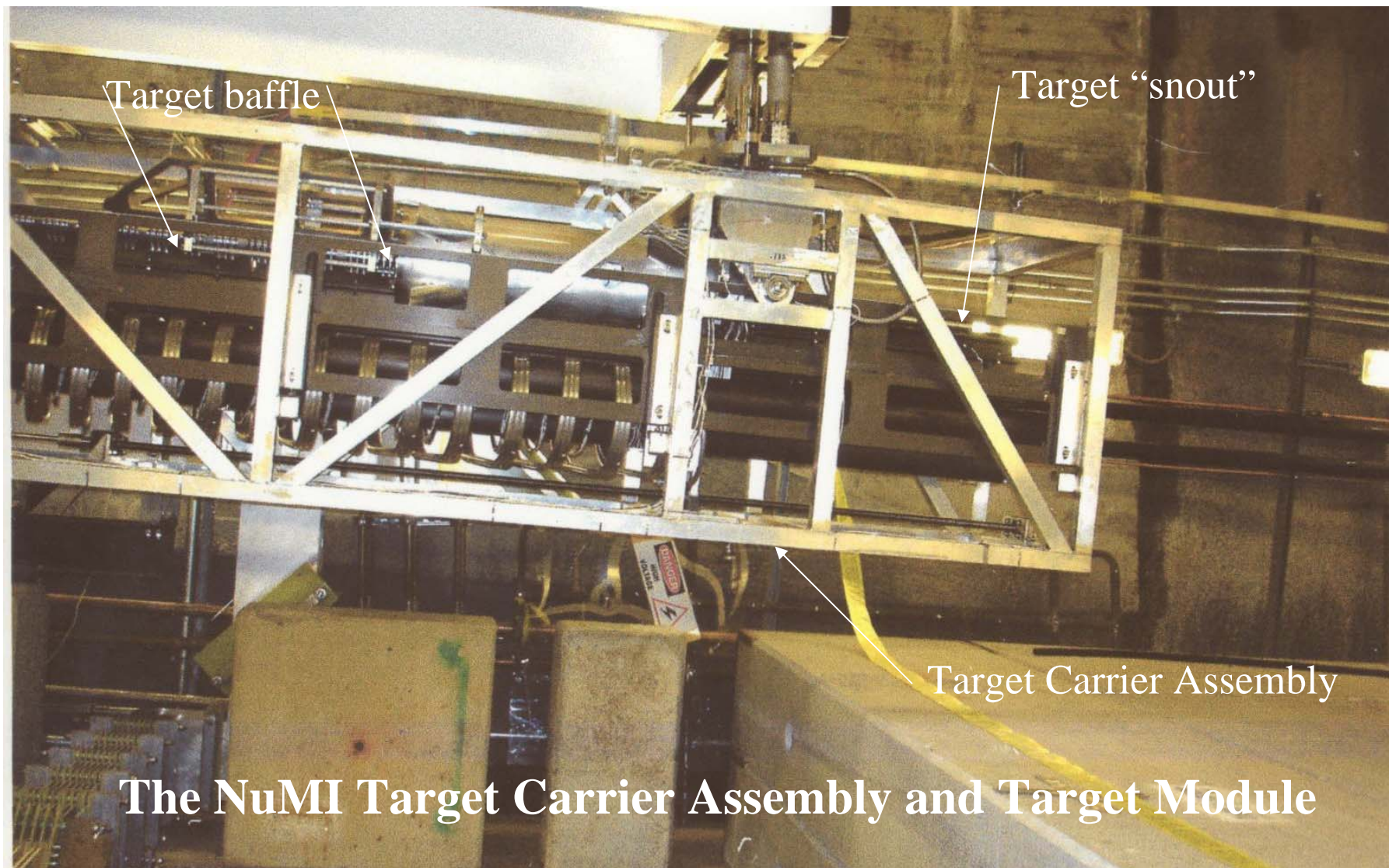
Leak thought to be here



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NuMI Target Situation/Status(16)

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Plans for week of April 18

- 1) The plan is now to return the target module into the beam using pressurized Helium in the vacuum space, and to lower the water pressure so that if the leak redevelops it will be contained.
- 2) A modification to the upstream beryllium window is being made to mount it on a new spool piece with a new vacuum port “T” (actually the pressurized Helium port.) This will allow a relocation of the “inlet” to the bottom of the can so that if the can is again flooded it can be pumped out.
- 3) Perhaps by Wednesday the module will be reinserted into the target pile and a low power/low intensity scan will be made with beam. We will run with pressurized Helium rather than vacuum.
- 4) If/when the leak reappears we will then consider using the English “stop leak”.



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Longer term:

- 1) Modifications to the second (spare) target are being considered.**
- 2) An air cooled (lower power/lower intensity) back up target is being designed and built. Different materials require the MINOS Experiment to consider the use of this alternate target.**
- 3) Given the very long lead times involved, additional spare target materials have been ordered, and arrangements for production in Russia are being negotiated.**